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[Original]

Ant Communities on the Campus of UOEH and in an Adjacent Natural Forest

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Abstract: Ant fauna was studied on newly constructed ground and a secondary forest on the campus of the University of Occupational and Environmental Health, Japan (UOEH), and in an adjacent natural forest in October and November of 1982. Collections of ants were made by honey bait traps and by hand sorting. Faunal analysis was made by the same procedure as is usually done by plant sociologists. In the natural forest (Symploco glaucae–Castanopsietum sieboldii Miyawaki *et al.*) and in the secondary forest, *Crematogaster osakensis* Forel and *Paratrechina flavipes* (F. Smith) showed high constancy and high relative coverage, and *Brachyponera chinensis* (Emery), *Aphaenogaster japonica* Forel, *Strumigenys lewisi* Cameron, *Weberistruma japonica* (Ito) and *Oligomyrmex sauteri* Forel showed high constancy. On the abandoned grassland, *Paratrechina flavipes* (F. Smith), *Tetramorium caespitum* (Linnaeus), *Crematogaster osakensis* Forel, *Lasius niger* (Linnaeus), *Iridomyrmex glaber* (Mayr) showed medium constancy and low relative coverage. On the other hand, a newly constructed lawn was inhabited by no or only a few kinds of ants, such as *Tetramorium caespitim* (Linnaeus), *Formica japonica* Motschulsky and *Pheidole nodus* F. Smith showing low constancy and low relative coverage. The ant fauna of shrubberies was the most plentiful among the sites studied. It contained lawn fauna, grassland fauna and fauna that originated from the marginal forest vegetation, which were carried with transplantation of garden trees.

Key words: ant community, constancy, relative coverage, aggregative behaviour, Kitakyushu.

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Introduction

The University of Occupational and Environmental Health, Japan (UOEH) was newly established in 1978 at the west corner of the famous iron-refinery area, Kitakyushu City, Kyushu Island, Japan. Since the surface soil was leveled to make the campus site, the greater part of the secondary mixed deciduous and evergreen broad-leaved forest present in the area was destroyed. A fraction of this forest remains now in a small area on the campus. After the construction of the campus site, some trees, shrubs and lawn were planted to make gardens. These artificial sites are profitable for the study of the earlier stage of ecosystem succession including the study of human impact upon the ant fauna. One of the authors, Kitazawa, studied the ecosystem succession of this area including the UOEH campus and a natural forest, and published a series of papers with his collaborators (Itow *et al.*, 1981; Okuma & Kitazawa, 1982; Tanaka & Kitazawa, 1982; Nakanishi & Kitazawa, 1982). The aim of this study is to describe the ant communities

on the campus and to compare them with the community in the natural vegetation.

Study Sites

We selected the following six vegetation types as study sites. The sites on the UOEH campus are nearly the same as those described in the study of the spider (Okuma & Kitazawa, 1982), Collembola (Tanaka & Kitazawa, 1982) and of Bryophyta (Nakanishi & Kitazawa, 1982). The vegetation study was done by Itow *et al.* (1981) (Fig. 1). For the comparison, a natural evergreen broad-leaved forest was selected as a site.

Natural evergreen broad-leaved forest

This forest has been reserved behind an old farmer's house under nearly natural conditions. The forest is located on the eastern slope of a hill, 30—50 m above sea level and 7.5 km south west of the UOEH campus. It is dominated by about 250-year-old

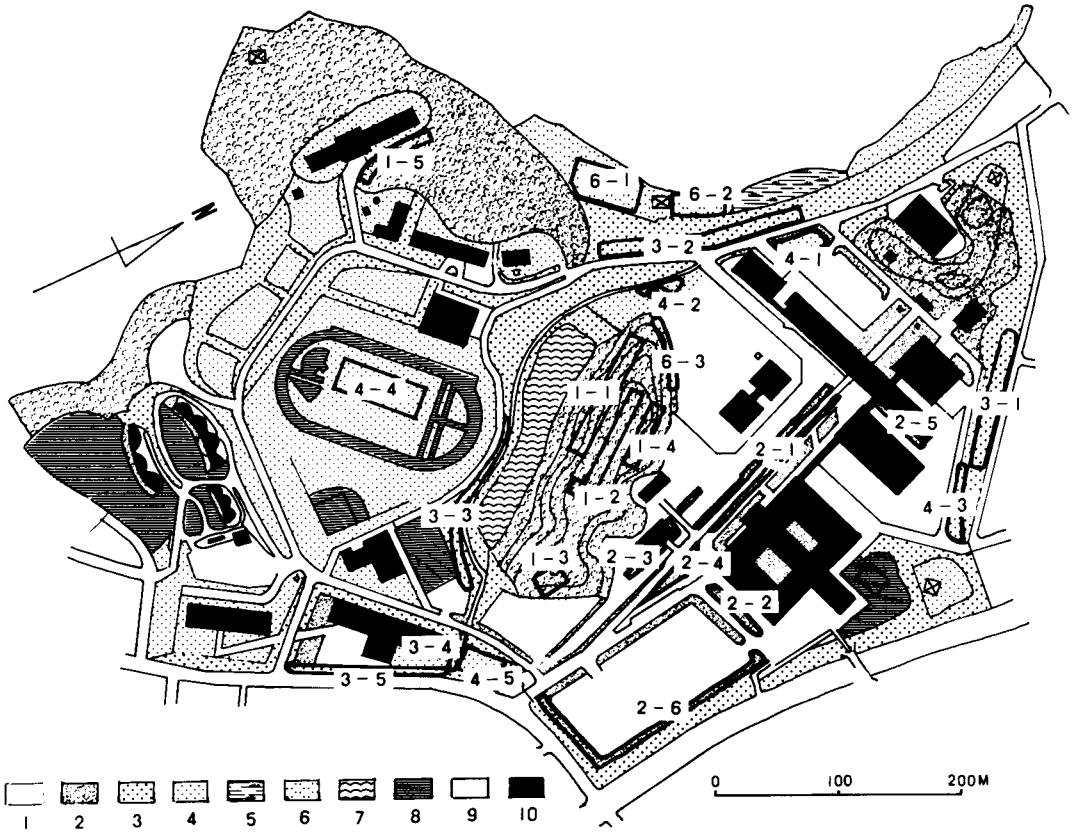

Fig. 1. Physiognomic map of UOEH campus showing the study sites.
1: Secondary forest, 2: Shrubbery, 3: Lawn on the slope, 4: Lawn on the flat ground, 5: Wetland, 6 Abandoned field of grasses and forbs, 7: Reservoire, 8: Bare ground, 9: Pavement, 10: Building.

Castanopsis sieboldii Nakai accompanied by *Symplocos glauca* Koidzumi and other plants. This stand seems to be the same as Symloco glaucae-Castanopsietum sieboldii by Miyawaki *et al.* (1971). The diameter at breast height of the largest *C. sieboldii* has attained 100 cm. This forest is a climax one on low hills with mesic yellowish brown forest soil and is one of the representative plant associations in the warm-temperate evergreen broad-leaved forests in Japan. The forest floor was dark and covered with fallen leaves and twigs with a few herbs protruding. The samples taken from this forest were numbered as 0-1 and 0-2.

Secondary mixed deciduous and evergreen broad-leaved forest

This site is a secondary forest consisting of deciduous and evergreen broad-leaved trees remaining on a low hill on the UOEH campus. The main deciduous trees are *Quercus serrata* Thumberg, *Rhus succedance* Linnaeus, *Mallotus japonicus* Mueller-Arg. and the main evergreen trees are *Symplocos lucida* Siebold et Zuccarini, *Dendropanacus trifidus* Makino and *Ligstrum japonicum* Thumberg (Itow *et al.*, 1981). Even the largest trees are less than 30 years in age, smaller than 10 m in height and less than 20 cm in diameter at breast height. The samples taken from this forest were numbered as 1-1, 1-2, 1-3 and 1-4.

Shrubbery

There are many planted shrubberies on the UOEH campus. Shrub species of the study site were *Abelia glandiflora* Rhed., *Enkianthus pelulatus* Schneider, *Rhododendron oomurasaki* Makino, *R. indicum* Sweet, *Daphne odora* Thumberg, *Ilex crenata* Thumberg, *Rhaphiolepis indica* Lindley and *Eurya emarginata* Makino. They were trimmed to 40—60 cm in height. Other tall trees such as *Ardisia crenata* Sims, *Acer buergerianum* Miquel, *Ternstroemia gymnanthera* Sprague, *Camellia sasanqua* Thumberg, *Cinnamomum camphora* Siebold, *Zelkova serrata* Makino and *Myrica rubra* Siebold *et* Zuccarini, were also planted in rows among the shrubs. The samples taken from this site were numbered as 2-1, 2-2, 2-3, 2-4, 2-5 and 2-6.

Lawn area on the slope and on the flat ground

Two types of study sites were chosen in lawn areas on the UOEH campus. One was sloping and the other was on flat ground. *Zoysia japonica* Steudel, about 5 to 10 cm high, has grown there for one to four years. The samples taken from the slope site were numbered as 3-1, 3-2, 3-3, 3-4 and those taken from the flat site were numbered as 4-1, 4-2, 4-3, 4-4 and 4-5.

Abandoned field of grass and forbs

There is a small fraction of abandoned field at the west corner of the UOEH campus. There were many gramineous, cyperaceous, composite weeds making clusters about 1 m high mixed with other herbs. The samples taken from this site were numbered as 6-1, 6-2 and 6-3.

The wetlands, barelands and pavement areas on the UOEH campus were omitted from the study area because no settled inhabitation of ants was expected.

Methods

For the collection of ants, we applied a cup shaped trap made of aluminium foil containing honey, which was diluted to one-third by water, scrapped cheese and ground meat as attractants. These attractants were effective for the nectar-philous and carnivorous ants. As no distinct difference of the effectiveness among these attractants could be found, we treated all data together. The most practical and excellent attractant was the diluted honey, because other attractants deformed the ant specimens due to their adhesiveness. Moreover, the small-sized carnivorous ants which feed on milliped eggs or hunt out geophilomorph centipedes were not attracted to these substances.

The aluminium foil traps were set on the ground at an interval of 2 to 2.5 m. The time spent during setting of 90 traps was about 2 hours. Each trap was exposed over 3 hours for the attracting of ants.

The ant species caught by the traps were identified by Kondoh and Mr. Masao Kubota and numbers were counted by species. The ratio of the occupied traps to all the exposed traps at each site was defined as an index of relative coverage of all kind of ants. The same ratio of each kind of ant at the same site was also examined. Practically, we have classified the index of relative coverage into ten degrees; + and 1 to 9 for each ten per cent (Table 1). The constancy of every kind of ant in the site was not determined because the samples were too small to calculate it. Instead, semi-quantitative expressions were adopted. The mean logarithmic number with its standard deviation of each kind of ant in the occupied traps was also calculated as an index of aggregative behaviour by each sample. These indexes, relative coverage, constancy and an index of aggregative behaviour correspond to the coverage, the constancy and the sociability in plant sociology by Braun-Blanqet & Pavillard (1930).

One set of sample consisted of 18 to 90 traps. The data of all samples were summarized to show the faunal composition with relative coverage in Table 1.

We took some duplicates of samples at the sites of 2-5 and 2-6. The duplicate data of the relative coverage of 2-5 showed the same results and those of 2-6 showed the same order of the relative coverage. There were many kinds of ants with smaller relative coverage in our night samples.

Samplings were done in October and November of 1982. These samplings were found to be sufficient to understand the faunal composition there.

Results and Discussion

Ants were classified into five groups (Table 1).

Table 1. Ant communities at the different vegetations on and near the UOEH campus. Index of relative coverage, the ratio of the occupied traps to all the exposed ones is shown by + and 1 to 9 for each ten per cent. An asterisk shows the case in which we obtained few specimens during the research

Type of vegetation		Natural forest		Secondary forest				Shrubbery							Abandoned field of grass and forbs			Lawn on the slope						Lawn on the flat ground					
Study site (D: day, N: night)		0—1	0—2	1—1	1—2	1—3	1—4	2—1	2—2	2—3	2—4	2—5	2—5	2—6D	2—6N	6—1	6—2	6—3	3—1	3—2	3—3	3—4	3—5	4—1	4—2	4—3	4—4	4—5			
Date		Oct. 25	Oct. 25	Oct. 27	Nov. 12	Nov. 13	Nov. 22	Oct. 27	Nov. 5	Nov. 6	Nov. 6	Nov. 7	Nov. 13	Nov. 13	Nov. 14	Nov. 4	Nov. 4	Nov. 29	Nov. 23	Nov. 23	Nov. 23	Nov. 24	Nov. 24	Oct. 25	Oct. 25	Nov. 23	Nov. 24	Nov. 24			
Nnmber of traps		81	85	76	76	79	83	85	79	34	90	18	18	62	62	50	39	49	80	82	80	59	80	73	67	80	80	80			
Group A																															
Brachiponera Chinensis (Emery)	オオハリアリ	+	+		+	+	+	+	2	+	+				+				+						+						
Crematogaster osakensis Forel	キイロシリアゲアリ	5	6	2	7	6	7	+								+		1													
Paratrechina flavipes (F. Smith)	アメイロアリ	4	5	1	6	6	7	1	1	1	1	1	1		+	+	+	4	+												
Group B																															
Strumigenys lewisi Cameron	ウロコアリ	•	•	•	•	•	•																								
Weberistruma japonica (Ito)	ヤマトウロコアリ	•	•	•	•	•	•																								
Aphaenogaster japonica Forel	ヤマアシナガアリ	+	+	+	+	1	+																								
Oligomyrmex sauteri Forel	コツノアリ	•	•	•	+	•	•																								
Group C																															
Camponotus tokioensis Ito	ウメマツオオアリ			+	+	+	+										+														
Camponotus sp.	オオアリ					+																									
Lasius spathepus Wheeler	クサアリモドキ				+			+																							
Group D																															
Tetramorium caespitum (Linnaeus)	トビイロシワアリ					+		2	2	1	4	4	3	2	1	1	1	+	+	+			+	+	1	+					
Formica japonica Motschulsky	クロヤマアリ							+	+	+	1			4	3	+			+	2	+	+	+		+					+	
Pheidole nodus F. Smith	オオズアカアリ						+			4	1	1	2			1	+	+	+	2			+							+	
Lasius niger (Linnaeus)	トビイロケアリ							1	+	1	+		+			1	2			+					+						
Camponotus japonicus Mayr	クロオオアリ							+			+			+	+										+						
Pristomyrmex pungens Mayr	アミメアリ									+			+		+	+									+						
Iridomyrmex glaber (Mayr)	ルリアリ							+						+	+	1	1														
Group E																															
Monomorium nipponense Wheeler	ヒメアリ							+								+															
Monomorium minutum Mayr	クロヒメアリ		+					+																							
Diplorhoptrum japonicum (Wheeler)	トフシアリ							+							+																
Vollenhovia emeryi Wheeler	ウメマツアリ															+															
Lasius sakagamii Yamauchi et Hayashida	カワラトビイロケアリ							+																							
Lasius flavus (Fabricius)	キイロケアリ												+																		
Paratrechina sakurae Ito	サクラアリ														+																
unknown species (Female)								+																							
Index of relative coverage in the study site		6	7	3	8	8	9	5	6	6	6	6	6	5	4	4	5	4	+	4	+	+	1	+	2	+	0	1			

Group A: Ants which are found in all study sites

This group consists of *Crematogaster osakensis* Forel, *Paratrechina flavipes* (F. Smith), and *Brachyponera chinensis* (Emery). Their constancy is high in the natural and secondary forests but low in the grassland and lawn. The nectar-philous ants, *Crematogaster osakensis* and *Paratrechina flavipes* show high relative coverage and high aggregative behaviour (Figs. 2 and 3). On the other hand, carnivorous ant, *Brachyponera chinensis* shows low relative coverage and low aggregative behaviour in spite of high constancy (Fig. 4). These species are found mainly in the natural and secondary forests, and appear sometimes at the margin of the grassland and in the shrubbery.

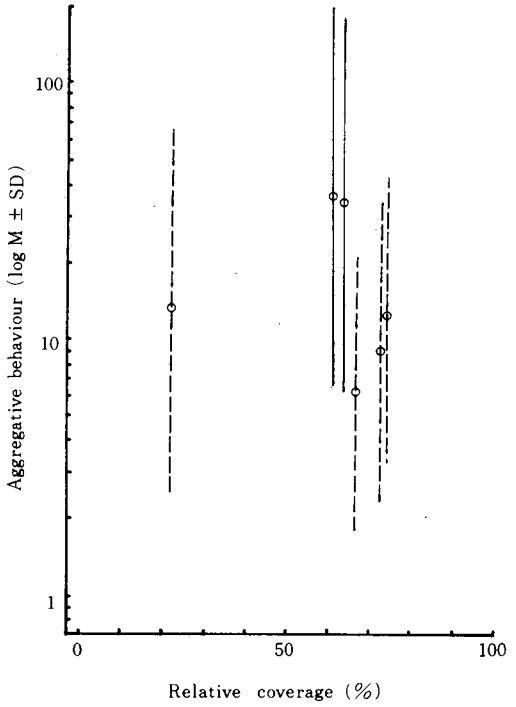

Fig. 2. The relative coverage and the aggregative behaviour of *Crematogaster osakensis* Forel in the different vegetations.
—— : in the natural forest
– – : in the secondary forest

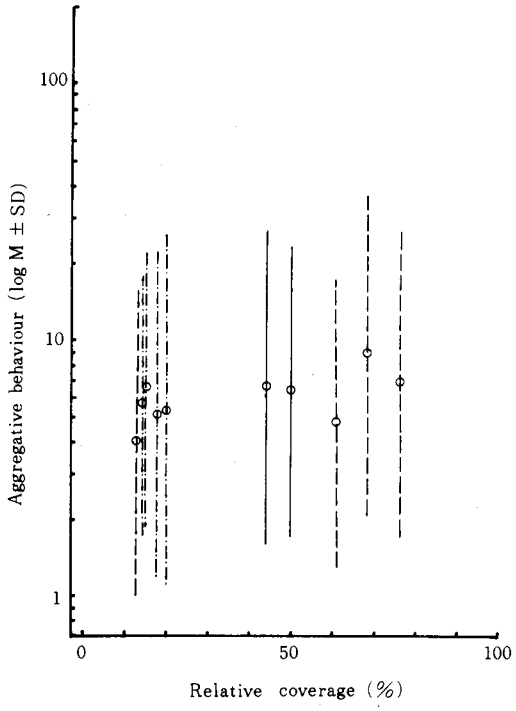

Fig. 3. The relative coverge and the aggregative behaviour of *Paratrechina flavipes* (F. Smith) in the different vegetations.
—— : in the natural forest
– – : in the secondary forest
–·– : in the shrubbery

Group B : Ants in the natural and secondary forests

This group consists of *Aphaenogaster japonica* Forel, *Strumigenys lewisi* Camelon, *Weberstruma japonica* (Ito) and *Oligomyrmex sauteri* Forel. They are carnivorous species living in the litter layer and the surface layer of humus soil. The relative coverage and aggregative behaviour of these species are low as seen in *Brachyponera chinensis*. The worker ants of *Aphaenogaster japonica* are easily attracted to a honey trap owing to their nectar-philous behaviour. But they carry the soil particles to cover the honey after a few minutes eating, because their capacity of the crop is relatively small. So, *Aphaenogaster japonica* may be called a semi-nectar-philous ant. On the other hand, *Strumigenys lewisi, Weberistruma japonica* and *Oligomyrmex sauteri* are small-sized carnivorous ants, which are rarely attracted by honey. These species have specifically developed feeding habits to capture soil mesofauna. Therefore, these species show high constancy in spite of low relative coverage and low aggregative behaviour in the forest, where the litter layer is rich and stable.

Group C : Ants characteristic of marginal vegetation of the forest

Lasius spathepus Wheeler and *Camponotus tokioensis* Ito are sometimes found in the marginal zone of the forest. These ants are nectar-philous and dependent on the trees for obtaining honeydew from aphids and coccids or for nesting in hollows of branches or trunks. The relative coverage, constancy and the aggregative behaviour of these species are low except for *Camponotus tokioensis* which have a high constancy. *Lasius spathepus* makes a feeding trail on the trunk and on the forest floor.

Group D : Ants characteristic of every type of grassland

This group consists of two subgroups. One of the subgroups consists of *Tetramorium caespitum* (Linnaeus), *Formica japonica* Motschulsky and *Pheidole nodus* F. Smith. These species show high constancy and from medium to low relative coverage. *Tetramorium caespitum* and *Pheidole nodus* show high aggregative behaviour (Figs. 5 and 6). These species are semi-nectar-philous, and have the habit of covering the honey with soil particles. *Formica japonica* forage solitarily, but are found in aggregation when food is plentiful (Fig. 7).

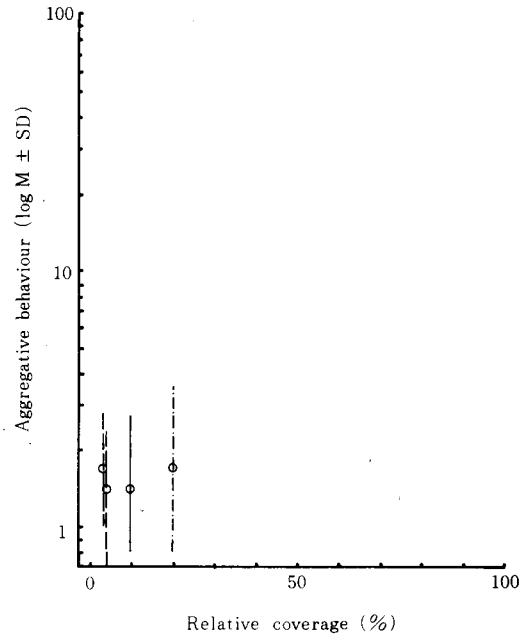

Fig. 4. The relative coverage and the aggregative behaviour of *Brachyponera chinensis* (Emery) in the different vegetations.
—— : in the natural forest
– – : in the secondary forest
–·– : in the shrubbery

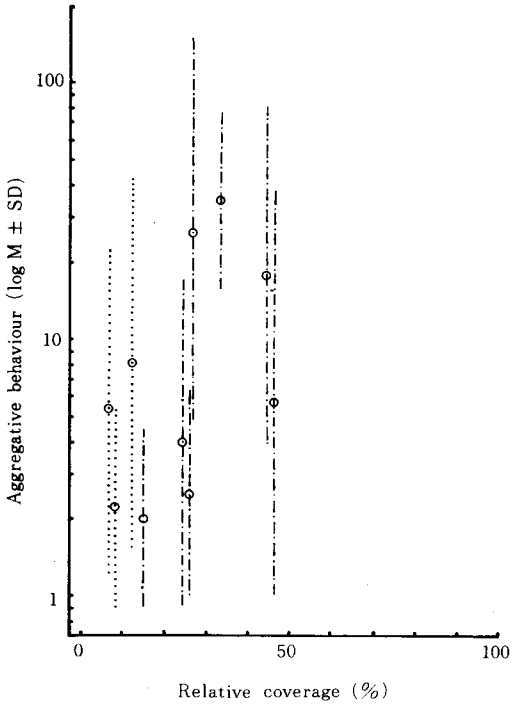

Fig. 5. The relative coverage and the aggregative behaviour of *Tetramorium caespitum* (Linnaeus) in the different vegetations.
–·– : in the shrubbery
···· : on the lawn

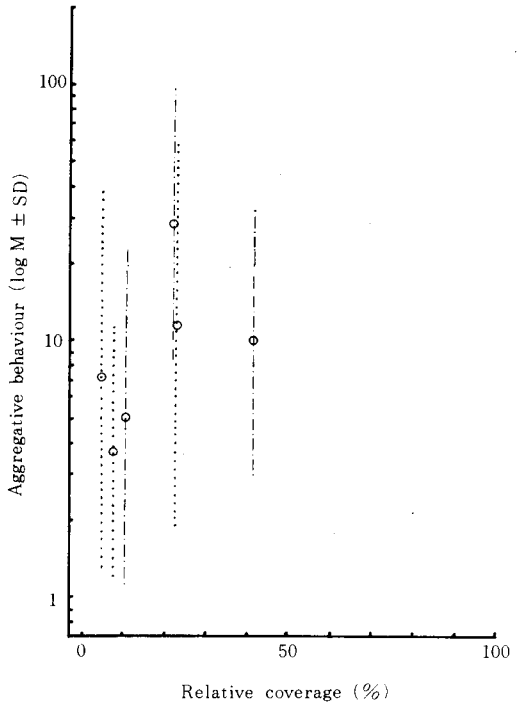

Fig. 6. The relative coverage and aggregative behaviour of *Pheidole nodus* F. Smith in the different vegetations.
–·– : in the shrubbery
···· : on the lawn

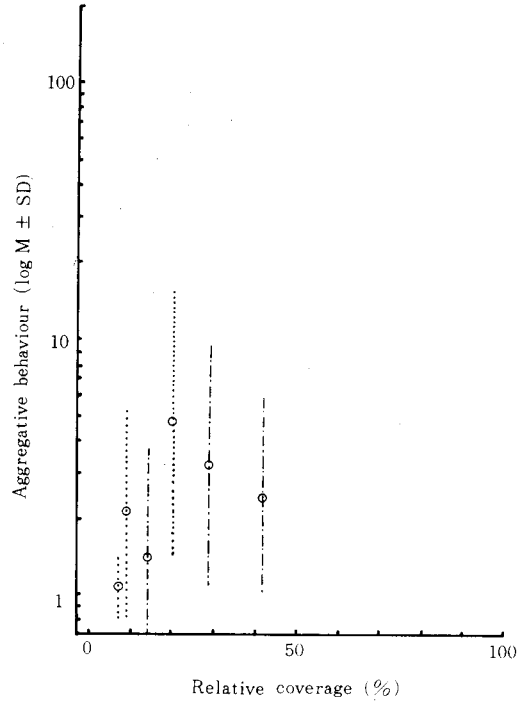

Fig. 7. The relative coverage and the aggregative behaviour of *Formica japonica* Motschulsky in the different vegetations.
–·– : in the shrubbery
···· : on the lawn

The other sub group consists of grassland species, which show low constancy, such as *Lasius niger* (Linnaeus), *Camponotus japonicus* Mayr, *Pristomyrmex pungens* Mayr and *Iridomyrmex glaber* (Mayr). *Lasius niger* and *Iridomyrmex glaber* use trees and shrubs for their nest sites. Accordingly, the border of the forest, shrubbery and the lawn accompanied with shrubs are their typical habitats.

Group E : Companion species

The constancy and relative coverage of the following species are low, and they are listed as companion species; *Vollenhovia emeryi* Wheeler, *Monomorium nipponense* Wheeler, *Monomorium minutum* Mayr, *Diplorhoptrum japonicum* (Wheeler), *Lasius flavus* (Fabricius) and *Paratrechina sakurae* Ito.

From the descriptions mentioned above, the life form groups of the fauna can be summarized as follows.

Natural evergreen broad-leaved forest (Symploco glaucae–Castanopsis sieboldii) and secondary mixed evergreen broad-leaved and deciduous forest

Ants showing high constancy and high relative coverage :

Crematogaster osakensis Forel キイロシリアゲアリ

Paratrechina flavipes (F. Smith) アメイロアリ

Ants showing high constancy :

Brachyponera chinensis (Emery) オオハリアリ

Aphaenogaster japonica Forel ヤマアシナガアリ

Strumigenys lewisi Camelon ウロコアリ

Weberistruma japonica (Ito) ヤマトウロコアリ

Oligomyrmex sauteri Forel コツノアリ

Ants in marginal vegetation :

Lasius niger (Linnaeus) トビイロケアリ

Lasius spathepus Wheeler クサアリモドキ

Camponotus tokioensis Ito ウメマツオオアリ

Iridomyrmex glaber (Mayr) ルリアリ

Companion species :

Monomorium minutum Mayr クロヒメアリ

Diplorhoptrum japonicum (Wheeler) トフシアリ

Shrubbery

Ants showing high constancy :

Tetramorium caespitum (Linnaeus) トビイロシワアリ

Formica japonica Motschulsky クロヤマアリ

Pheidole nodus F. Smith オオズアカアリ

Lasius niger (Linnaeus) トビイロケアリ

Paratrechina flavipes (F. Smith) アメイロアリ

Brachyponera chinensis (Emery) オオハリアリ

Ants showing medium constancy :

Camponotus japonicus Mayr クロオオアリ

Pristomyrmex pungens Mayr アミメアリ

Companion species :

Crematogaster osakensis Forel キイロシリアゲアリ

Weberistruma japonica (Ito) ヤマトウロコアリ

Lasius spathepus Wheeler クサアリモドキ

Lasius flavus (Fabricius) キイロケアリ

Monomorium minutum Mayr クロヒメアリ

Diplorhoptrum japonicum (Wheeler) トフシアリ

Abandoned grassland

Ants showing high constancy :

Paratrechina flavipes (F. Smith) アメイロアリ

Tetramorium caespitum (Linnaeus) トビイロシワアリ

Ants showing medium constancy :

Crematogaster osakensis Forel キイロシリアゲアリ

Lasius niger (Linnaeus) トビイロケアリ

Iridomyrmex glaber (Mayr) ルリアリ

Companion species :

Pheidole nodus F. Smith オオズアカアリ

Vollenhovia emeryi Wheeler ウメマツアリ

Monomorium nipponense Wheeler ヒメアリ

Formica japonica Motschulsky クロヤマアリ

Camponotus japonicus Mayr クロオオアリ

Camponotus tokioensis Ito ウメマツオオアリ

Lawn

Ants showing high constancy

Tetramorium caespitum (Linnaeus) トビイロシワアリ

Formica japonica Motschulsky クロヤマアリ

Companion species :

Crematogaster osakensis Forel キイロシリアゲアリ

Brachyponera chinensis (Emery) オオハリアリ

Pheidole nodus F. Smith オオズアカアリ

Lasius niger (Linnaeus) トビイロケアリ

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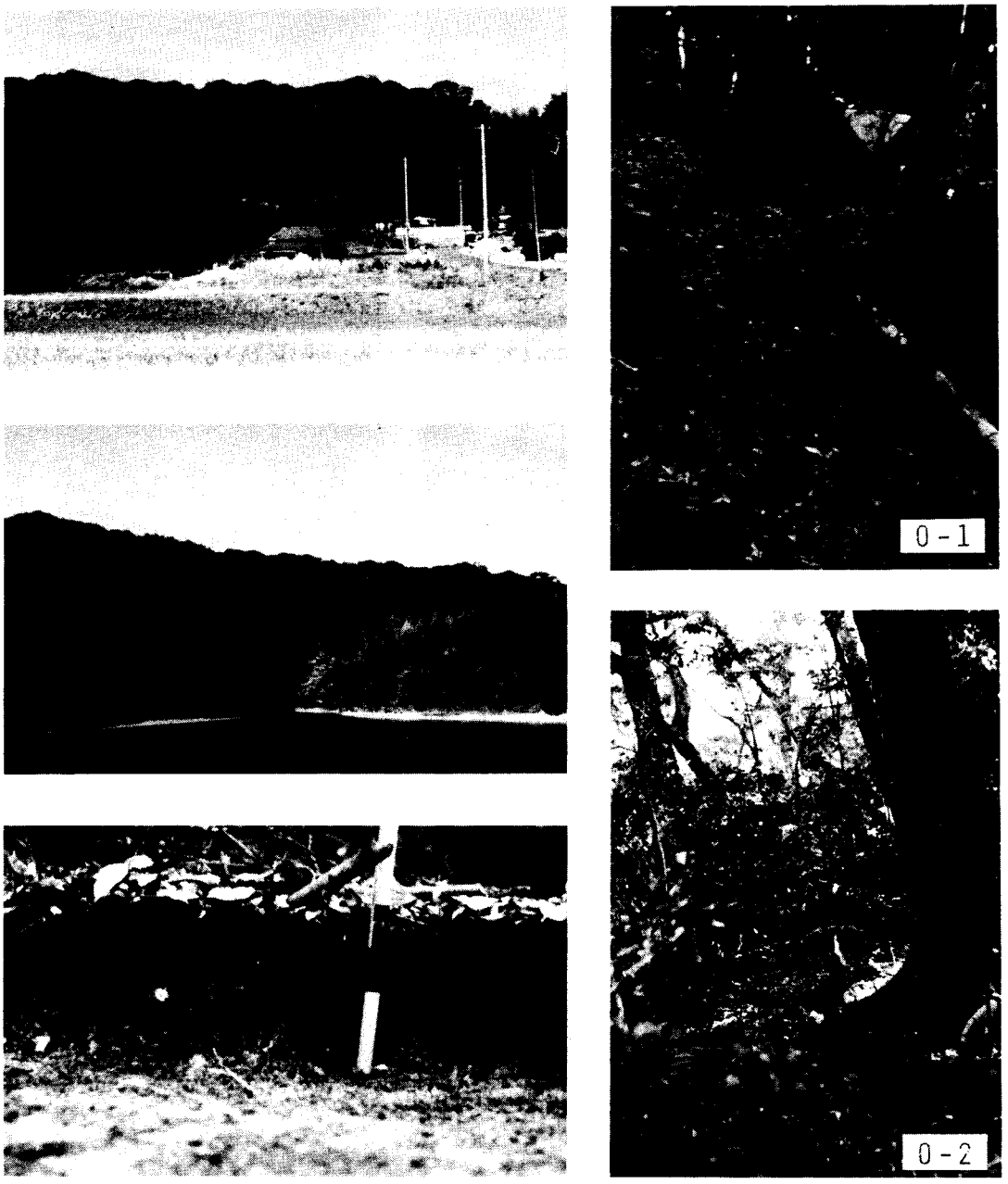

Plate 1. The natural forest where the samples 0-1 and 0-2 were taken (left upper and middle). The soil profile of the natural forest (left bottom). The sampling sites 0-1 (right upper) and 0-2 (right bottom) in the natural forest.

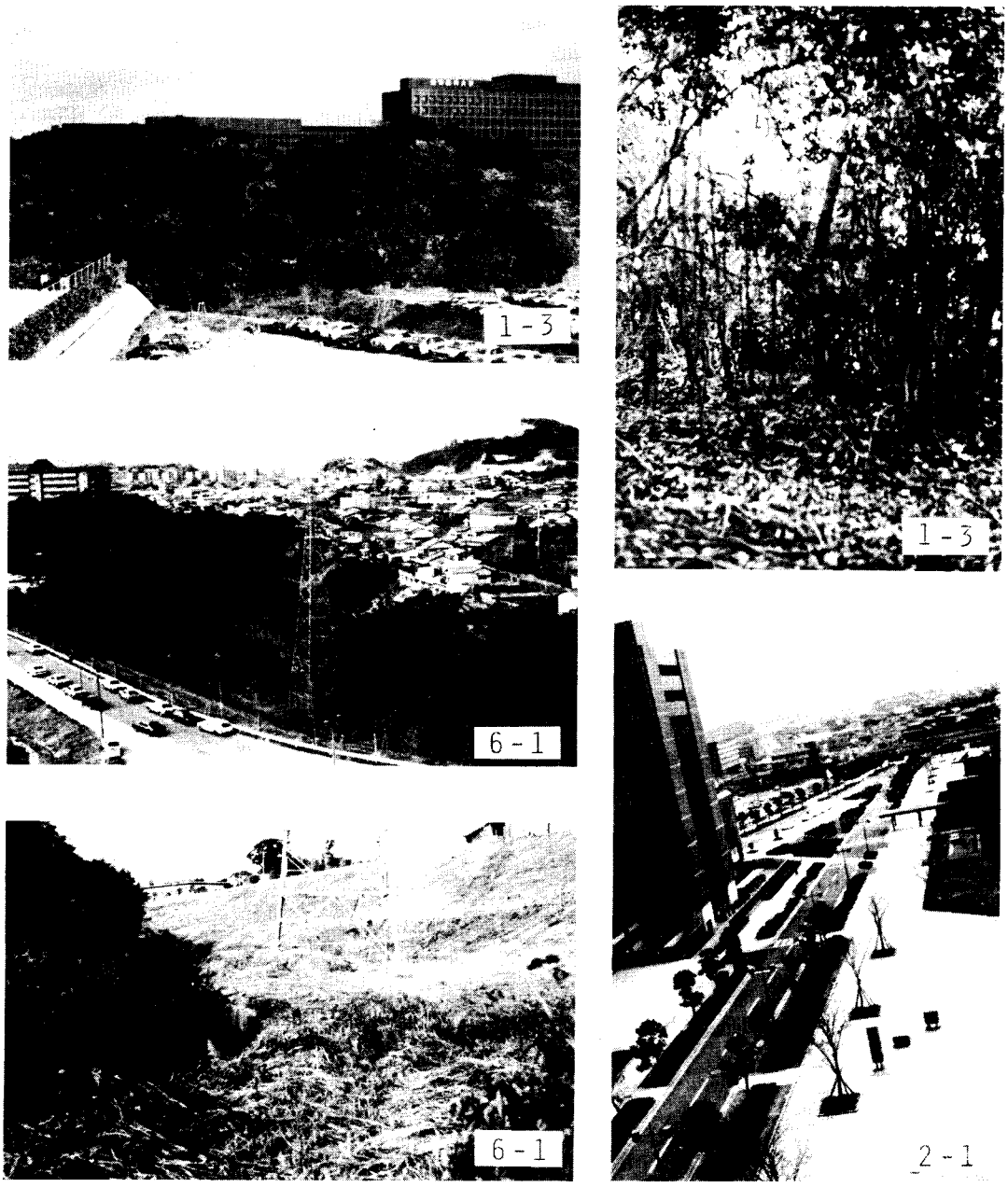

Plate 2. The secondary forest where the samples 1-1 to 1-4 were taken, especially showing site 1-3 (left upper). The abandoned field site (left middle and bottom). Inside of the secondary forest at the site 1-3 (right upper). One of the shrubberies, 2-1 (right bottom).

Plate 3. The lawn on the flat ground; 4-1 where *Tetramorium caespitum* (Wheeler) was found (upper), 4-2 where *Formica japonica* Motschulsky, *Pheidole nodus* F. Smith, etc. were also found (middle) and 4-4 where no ants were found (bottom).

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産業医科大学構内と付近の自然林のアリ類群集の比較

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要 旨: 産業医科大学構内と付近の自然林で1982年10月と11月に蜂蜜などを用いたベイト・トラップを設置して誘引されたアリの種類と数を調査した．ミミズバイ・スダジイ群集（自然林）と萌芽林を含む二次林にはキイロシリアゲアリ，アメイロアリが高常在度，高相対被度で，オオハリアリ，ヤマアシナガアリ，ウロコアリ，ヤマトウロコアリ，コツノアリが高常在度で生息し，放棄された草地にはアメイロアリ，トビイロシワアリ，キイロシリアゲアリ，トビイロケアリ，ルリアリが中低常在度で見つかった．造成地の芝生は平面・斜面ともアリ群集は貧弱でトビイロシワアリ，クロヤマアリ，オオズアカアリが低常在度で見つかっている．運動場の芝生では全くアリが見つかっていない．植込があると，植木と共に移入されたアリが組みこまれることが目立った特徴である．これらは林縁性のアリと草地・芝地性のアリの組み合わせのアリ群集といえる．

J. UOEH（産業医大誌），6（3）: 221–234 (1984)